Federated Learning for Internet of Things: A Comprehensive Survey

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Abstract

The Internet of Things (IoT) is penetrating many facets of our daily life with the proliferation of intelligent services and applications empowered by artificial intelligence (AI). Traditionally, AI techniques require centralized data collection and processing that may not be feasible in realistic application scenarios due to the high scalability of modern IoT networks and growing data privacy concerns. Federated Learning (FL) has emerged as a distributed collaborative AI approach that can enable many intelligent IoT applications, by allowing for AI training at distributed IoT devices without the need for data sharing. In this article, we provide a comprehensive survey of the emerging applications of FL in IoT networks, beginning from an introduction to the recent advances in FL and IoT to a discussion of their integration. Particularly, we explore and analyze the potential of FL for enabling a wide range of IoT services, including IoT data sharing, data offloading and caching, attack detection, localization, mobile crowdsensing, and IoT privacy and security. We then provide an extensive survey of the use of FL in various key IoT applications such as smart healthcare, smart transportation, Unmanned Aerial Vehicles (UAVs), smart cities, and smart industry. The important lessons learned from this review of the FL-IoT services and applications are also highlighted. We complete this survey by highlighting the current challenges and possible directions for future research in this booming area.